California Environmental Protection Agency

Air Resources Board

PERMEATION RATES OF HIGH - DENSITY POLYETHYLENE FUEL TANKS (June 2001)

Engineering and Certification Branch
Monitoring and Laboratory Division

June 12, 2001

PERMEATION RATES OF HIGH - DENSITY POLYETHYLENE FUEL TANKS (June 2001)

Introduction

The California Air Resources Board (CARB) staff tested 25 High-Density Polyethylene (HDPE) fuel tanks to determine their permeation rates. Tanks were preconditioned with commercial fuel with MTBE or ethanol oxygenates, refilled with Phase II California Reformulated Certification (CERT) fuel or commercial fuel containing ethanol, and subjected to a variable temperature profile. Permeation rates were then determined gravimetrically during the month of May.

Test Protocol

In April and May, the tanks underwent the preconditioning process. Tanks used with 4-cycle engines were preconditioned with commercial fuel or commercial fuel containing ethanol, per CARB Test Method 513. Tanks used with 2-cycle engines underwent the preconditioning process using a 2% commercial fuel/oil mixture. The tanks were stored at ambient temperature and pressure in flameproof storage cabinets. After at least four weeks of ambient preconditioning, the tanks were emptied; dried with compressed zero air, and immediately refilled with either CERT fuel, commercial fuel containing ethanol, or a 2% fuel mixture. The tanks were then sealed using a hand held fusion welder and 1/4" thick HDPE coupons and leak tested as specified in Test Method 513 (a copy can be found at the CARB web site: http://www.arb.ca.gov/regact/spillcon/spillcon.htm).

Weight loss was used to determine relative permeation rates. Sealed tanks were weighed using a 16,000-gram or 6,200-gram balances with sensitivities of ±0.1 and ± 0.01 grams respectively**.** After each tank was weighed, the weight was recorded. They were then placed in the Sealed Housing for Evaporative Determination (SHED) and exposed to a 1-day/24-hour/1440-minute variable temperature profile (see Attachment 1). This profile is considered our diurnal cycle (recurring every day). Tanks were then post weighed after each 24-hour diurnal cycle and the weight loss calculated.

Results

Cumulative weight losses were determined for each container as a function of time. The tanks underwent multiple diurnal cycles, but results are calculated using only the last five 24 hour cycles. Typically, the initial days of test data were not used in determining individual per container permeation rates due to variability. A summary of all test results can be found in Attachment 2.

The average permeation rate for the sulfonated one quart Tecumseh tank (35586) designated T1S was determined to be 2.72 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles. Certification fuel was used for testing.

The average permeation rate for the sulfonated one quart Tecumseh tank (35586) designated T2S was determined to be 2.78 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles. Certification fuel was used for testing.

The average permeation rate for the sulfonated one quart Tecumseh tank (35586) designated T3S was determined to be 2.71 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles. Certification fuel was used for testing.

The average permeation rate for the sulfonated one quart Tecumseh tank (35586) designated T4S was determined to be 2.94 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles. Certification fuel was used for testing.

The average permeation rate for the sulfonated one quart Briggs & Stratton tank (695106) designated T5S was determined to be 2.94 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles. Certification fuel was used for testing.

The average permeation rate for the sulfonated one quart Briggs & Stratton tank (695106) designated T6S was determined to be 2.91 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles. Commercial fuel containing ethanol was used for testing.

The average permeation rate for the sulfonated one quart Tecumseh tank (35586) designated T7S was determined to be 2.90 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles. Commercial fuel containing ethanol was used for testing.

The average permeation rate for the sulfonated one quart Tecumseh tank (35586) designated T8S was determined to be 0.71 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles. Commercial fuel containing ethanol was used for testing.

The average permeation rate for the sulfonated one quart Tecumseh tank (35586) designated T9S was determined to be 2.69 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles. Commercial fuel containing ethanol was used for testing.

The average permeation rate for the sulfonated one quart Tecumseh tank (35586) designated T10S was determined to be 3.71 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles. Commercial fuel containing ethanol was used for testing.

The average permeation rate for the sulfonated one quart Tecumseh tank (35586) designated T11S was determined to be 1.50 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles. Commercial fuel containing ethanol was used for testing.

The average permeation rate for the sulfonated one quart Tecumseh tank (35586) designated T12S was determined to be 0.24 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles. Commercial fuel containing ethanol was used for testing.

The average permeation rate for the sulfonated one quart Tecumseh tank (35586) designated T13S was determined to be 1.99 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles. Commercial fuel containing ethanol was used for testing.

The average permeation rate for the 3.9 gallon Toro tank (72045) designated T6-2 was determined to be 0.88 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles. Certification fuel was used for testing.

The average permeation rate for the 0.5 gallon Toro tank (20040) designated T19-2 was determined to be 2.44 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles. Certification fuel was used for testing.

The average permeation rate for 0.38 gallon fluorinated Lawn Boy tank (10363) designated T20FE was determined to be 0.56 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles. Commercial fuel containing ethanol was used for testing.

The average permeation rate for 0.38 gallon Lawn Boy tank (10363) designated T20-2 was determined to be 3.59 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles. Certification fuel was used for testing.

The average permeation rate for 0.25 gallon Yard Machine tank (11A-089S700) designated T23E was determined to be 3.71 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles. Commercial fuel containing ethanol was used for testing.

The average permeation rate for 0.25 gallon Tecumseh tank (35586) designated T29-2 was determined to be 2.52 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles. Certification fuel was used for testing.

The average permeation rate for 0.25 gallon Tecumseh tank (35586) designated T30-2 was determined to be 2.54 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles. Certification fuel was used for testing.

The average permeation rate for 0.25 gallon fluorinated Craftsman tank (917379440) designated T42FE was determined to be 0.51 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles. Commercial fuel containing ethanol was used for testing.

The average permeation rate for 0.25 gallon Craftsman tank (917379440) designated T42-2 was determined to be 4.40 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles. Certification fuel was used for testing.

The average permeation rate for 0.38 gallon fluorinated Craftsman tank (917389580) designated T43FE was determined to be 1.14 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles. Commercial fuel containing ethanol was used for testing.

The average permeation rate for 0.38 gallon Craftsman tank (917389580) designated T43-2 was determined to be 2.32 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles. Certification fuel was used for testing.

The average permeation rate for 0.25 gallon Yard Machine tank (11A-414D729) designated T44-2 was determined to be 3.60 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles. Certification fuel was used for testing.

Attachment 1

1 Day / 24 Hour / 1440 Minute Variable Temperature Profile

HOUR	MINUTE	TIME REMAINING (MINUTES)	TEMPERATURE (°F)
0	0	1440	65.0
1	60	1380	66.6
2	120	1320	72.6
3	180	1260	80.3
4	240	1200	86.1
5	300	1140	90.6
6	360	1080	94.6
7	420	1020	98.1
8	480	960	101.2
9	540	900	103.4
10	600	840	104.9
11	660	780	105.0
12	720	720	104.2
13	780	660	101.1
14	840	600	95.3
15	900	540	88.8
16	960	480	84.4
17	1020	420	80.8
18	1080	360	77.8
19	1140	300	75.3
20	1200	240	72.0
21	1260	180	70.0
22	1320	120	68.2
23	1380	60	66.5
24	1440	0	65.0

Attachment 2

Diurnal Cycles (# 24 hr cycles)	Tank Label	Mfg.	Tank Volume	Treatment Level	Test Dates	Fuel Type	Avg. Loss (g/gal/day)
5	1S	Tecumseh	0.25 gal	Sulfonated	May 22 - June 2	CERT	2.72
5	2S	Tecumseh	0.25 gal	Sulfonated	May 22 - June 2	CERT	2.78
5	3S	Tecumseh	0.25 gal	Sulfonated	May 22 - June 2	CERT	2.71
5	4S	Tecumseh	0.25 gal	Sulfonated	May 22 - June 2	CERT	2.94
5	5S	B&S Quantum	0.25 gal	Sulfonated	May 22 - June 2	CERT	2.94
5	6S	B&S Quantum	0.25 gal	Sulfonated	May 22 - June 2	Ethanol	2.91
5	7S	Tecumseh	0.25 gal	Sulfonated	May 22 - June 2	Ethanol	2.90
5	8S	Tecumseh	0.25 gal	Sulfonated	May 22 - June 2	Ethanol	0.71
5	9S	Tecumseh	0.25 gal	Sulfonated	May 22 - June 2	Ethanol	2.69
5	10S	Tecumseh	0.25 gal	Sulfonated	May 22 - June 2	Ethanol	3.71
5	11S	Tecumseh	0.25 gal	Sulfonated	May 22 - June 2	Ethanol	1.50
5	12S	Tecumseh	0.25 gal	Sulfonated	May 22 - June 2	Ethanol	0.24
5	13S	Tecumseh	0.25 gal	Sulfonated	May 22 - June 2	Ethanol	1.99
5	T6-2	Toro	3.9 gal	Untreated	May 23 - June 2	CERT	0.88
5	T19-2	Toro	0.5 gal	Untreated	May 23 - June 2	CERT	2.44
5	T20FE	Lawn Boy	0.38 gal	Fluorinated	May 23 - June 2	Ethanol	0.56
5	T20-2	Lawn Boy	0.38 gal	Untreated	May 23 - June 2	CERT	3.59
5	T23E	Yard Machine	0.25 gal	Untreated	May 23 - June 2	Ethanol	3.71
5	T29-2	Tecumseh	0.25 gal	Untreated	May 23 - June 2	CERT	2.52
5	T30-2	Tecumseh	0.25 gal	Untreated	May 23 - June 2	CERT	2.54
5	T42FE	Craftsman	0.25 gal	Fluorinated	May 23 - June 2	Ethanol	0.51
5	T42-2	Craftsman	0.25 gal	Untreated	May 23 - June 2	CERT	4.40
5	T43FE	Craftsman	0.38 gal	Fluorinated	May 23 - June 2	Ethanol	1.14
5	T43-2	Craftsman	0.38 gal	Untreated	May 23 - June 2	CERT	2.32
5	T44-2	Yard Machine	0.25 gal	Untreated	May 23 - June 2	CERT	3.60
						Average	**2.36**

Attachment 2 Continued

Label	Tare Weight (grams)	Fuel Density (grams/gal)
Tank T1S	279.90	2791

Date	Initial Weight	Finial Weight	Weight Loss	Permeation (grams/gal/day)
22-May	1008.41	1007.77	0.64	2.45
23-May	1007.77	1007.22	0.55	2.11
24-May	1007.22	1006.59	0.63	2.42
25-May	1006.59	1005.96	0.63	2.42
26-May	1005.96	1005.28	0.68	2.61
27-May	1005.28	1004.51	0.77	2.96
28-May	1004.51	1003.93	0.58	2.23
30-May	1003.56	1002.79	0.77	2.97
1-Jun	1002.79	1002.02	0.77	2.97
2-Jun	1002.02	1001.38	0.64	2.47

Std. Dev. Weight Loss Last Five Days	0.09	Avg. Permeation Last Five Days	2.72

Label	Tare Weight (grams)	Fuel Density (grams/gal)
Tank T2S	278.09	2791

Date	Initial Weight	Finial Weight	Weight Loss	Permeation (grams/gal/day)
22-May	1007.62	1006.95	0.67	2.56
23-May	1006.95	1006.38	0.57	2.18
24-May	1006.38	1005.73	0.65	2.49
25-May	1005.73	1005.06	0.67	2.57
26-May	1005.06	1004.37	0.69	2.65
27-May	1004.37	1003.59	0.78	3.00
28-May	1003.59	1002.99	0.60	2.31
30-May	1002.61	1001.83	0.78	3.00
1-Jun	1001.83	1001.10	0.73	2.82
2-Jun	1001.10	1000.38	0.72	2.78

Std. Dev. Weight Loss Last Five Days	0.07	Avg. Permeation Last Five Days	2.78

Attachment 2 Continued

	Label	Tare Weight (grams)	Fuel Density (grams/gal)	
	Tank T3S	274.91	2791	
Date	Initial Weight	Finial Weight	Weight Loss	Permeation (grams/gal/day)
22-May	999.64	999.02	0.62	2.39
23-May	999.02	998.50	0.52	2.00
24-May	998.50	997.86	0.64	2.47
25-May	997.86	997.24	0.62	2.39
26-May	997.24	996.58	0.66	2.55
27-May	996.58	995.81	0.77	2.98
28-May	995.81	995.25	0.56	2.17
30-May	994.91	994.15	0.76	2.95
1-Jun	994.15	993.44	0.71	2.76
2-Jun	993.44	992.74	0.70	2.72
	Std. Dev. Weight Loss Last Five Days	0.08	Avg. Permeation Last Five Days	2.71

	Label	Tare Weight (grams)	Fuel Density (grams/gal)	
	Tank T4S	273.90	2791	
Date	Initial Weight	Finial Weight	Weight Loss	Permeation (grams/gal/day)
22-May	965.55	964.91	0.64	2.58
23-May	964.91	964.38	0.53	2.14
24-May	964.38	963.72	0.66	2.67
25-May	963.72	963.08	0.64	2.59
26-May	963.08	962.41	0.67	2.71
27-May	962.41	961.61	0.80	3.24
28-May	961.61	961.03	0.58	2.35
30-May	960.67	959.88	0.79	3.21
1-Jun	959.88	959.16	0.72	2.93
2-Jun	959.16	958.43	0.73	2.97
	Std. Dev. Weight Loss Last Five Days	0.09	Avg. Permeation Last Five Days	2.94

Attachment 2 Continued

	Label	Tare Weight (grams)	Fuel Density (grams/gal)	
	Tank T5S	640.28	2791	
Date	Initial Weight	Finial Weight	Weight Loss	Permeation (grams/gal/day)
22-May	1396.15	1395.62	0.53	1.96
23-May	1395.62	1395.49	0.13	0.48
24-May	1395.49	1394.79	0.70	2.59
25-May	1394.79	1394.16	0.63	2.33
26-May	1394.16	1393.51	0.65	2.41
27-May	1393.51	1392.55	0.96	3.56
28-May	1392.55	1392.04	0.51	1.89
30-May	1392.01	1391.17	0.84	3.12
1-Jun	1391.17	1390.38	0.79	2.94
2-Jun	1390.38	1389.52	0.86	3.20
	Std. Dev. Weight Loss Last Five Days	0.17	Avg. Permeation Last Five Days	2.94

	Label	Tare Weight (grams)	Fuel Density (grams/gal)	
	Tank T6S	647.31	2828	
Date	Initial Weight	Finial Weight	Weight Loss	Permeation (grams/gal/day)
22-May	1571.07	1570.59	0.48	1.47
23-May	1570.59	1570.36	0.23	0.70
24-May	1570.36	1569.60	0.76	2.33
25-May	1569.60	1568.93	0.67	2.05
26-May	1568.93	1568.07	0.86	2.64
27-May	1568.07	1566.89	1.18	3.62
28-May	1566.89	1566.37	0.52	1.60
30-May	1566.42	1565.34	1.08	3.32
1-Jun	1565.34	1564.41	0.93	2.86
2-Jun	1564.41	1563.39	1.02	3.15
	Std. Dev. Weight Loss Last Five Days	0.25	Avg. Permeation Last Five Days	2.91

A**ttachment 2 Continued**

	Label	Tare Weight (grams)	Fuel Density (grams/gal)	
	Tank T7S	275.58	2828	
Date	Initial Weight	Finial Weight	Weight Loss	Permeation (grams/gal/day)
22-May	988.50	987.80	0.70	2.78
23-May	987.80	987.31	0.49	1.95
24-May	987.31	986.65	0.66	2.62
25-May	986.65	985.98	0.67	2.66
26-May	985.98	985.27	0.71	2.83
27-May	985.27	984.49	0.78	3.11
28-May	984.49	983.88	0.61	2.43
30-May	983.53	982.73	0.80	3.20
1-Jun	982.73	982.00	0.73	2.92
2-Jun	982.00	981.29	0.71	2.84
	Std. Dev. Weight Loss Last Five Days	0.07	Avg. Permeation Last Five Days	2.90

	Label	Tare Weight (grams)	Fuel Density (grams/gal)	
	Tank T8S	268.81	2828	
Date	Initial Weight	Finial Weight	Weight Loss	Permeation (grams/gal/day)
22-May	951.38	951.28	0.10	0.41
23-May	951.28	951.25	0.03	0.12
24-May	951.25	951.13	0.12	0.50
25-May	951.13	951.02	0.11	0.46
26-May	951.02	950.87	0.15	0.62
27-May	950.87	950.66	0.21	0.87
28-May	950.66	950.60	0.06	0.25
30-May	950.64	950.40	0.24	1.00
1-Jun	950.40	950.23	0.17	0.71
2-Jun	950.23	950.06	0.17	0.71
	Std. Dev. Weight Loss Last Five Days	0.07	Avg. Permeation Last Five Days	0.71

A**ttachment 2 Continued**

	Label	Tare Weight (grams)	Fuel Density (grams/gal)	
	Tank T9S	275.13	2828	
Date	Initial Weight	Finial Weight	Weight Loss	Permeation (grams/gal/day)
22-May	967.11	966.57	0.54	2.21
23-May	966.57	966.11	0.46	1.88
24-May	966.11	965.54	0.57	2.33
25-May	965.54	964.97	0.57	2.33
26-May	964.97	964.32	0.65	2.66
27-May	964.32	963.62	0.70	2.87
28-May	963.62	963.08	0.54	2.22
30-May	962.79	962.07	0.72	2.96
1-Jun	962.07	961.41	0.66	2.72
2-Jun	961.41	960.76	0.65	2.68
	Std. Dev. Weight Loss Last Five Days	0.07	Avg. Permeation Last Five Days	2.69

	Label	Tare Weight (grams)	Fuel Density (grams/gal)	
	Tank T10S	275.52	2828	
Date	Initial Weight	Finial Weight	Weight Loss	Permeation (grams/gal/day)
22-May	943.46	942.67	0.79	3.34
23-May	942.67	942.01	0.66	2.80
24-May	942.01	941.22	0.79	3.35
25-May	941.22	940.43	0.79	3.36
26-May	940.43	939.58	0.85	3.62
27-May	939.58	938.64	0.94	4.00
28-May	938.64	937.90	0.74	3.16
30-May	937.46	936.52	0.94	4.02
1-Jun	936.52	935.64	0.88	3.76
2-Jun	935.64	934.80	0.84	3.60
	Std. Dev. Weight Loss Last Five Days	0.08	Avg. Permeation Last Five Days	3.71

A**ttachment 2 Continued**

	Label	Tare Weight (grams)	Fuel Density (grams/gal)	
	Tank T11S	271.15	2828	
Date	Initial Weight	Finial Weight	Weight Loss	Permeation (grams/gal/day)
22-May	982.17	981.88	0.29	1.15
23-May	981.88	981.69	0.19	0.76
24-May	981.69	981.36	0.33	1.31
25-May	981.36	981.05	0.31	1.23
26-May	981.05	980.69	0.36	1.43
27-May	980.69	980.25	0.44	1.75
28-May	980.25	979.98	0.27	1.08
30-May	979.88	979.47	0.41	1.64
1-Jun	979.47	979.10	0.37	1.48
2-Jun	979.10	978.71	0.39	1.56
	Std. Dev. Weight Loss Last Five Days	0.06	Avg. Permeation Last Five Days	1.50

	Label	Tare Weight (grams)	Fuel Density (grams/gal)	
	Tank T12S	271.26	2828	
Date	Initial Weight	Finial Weight	Weight Loss	Permeation (grams/gal/day)
22-May	956.82	956.75	0.07	0.29
23-May	956.75	956.63	0.12	0.50
24-May	956.63	956.59	0.04	0.17
25-May	956.59	956.58	0.01	0.04
26-May	956.58	956.52	0.06	0.25
27-May	956.52	956.39	0.13	0.54
28-May	956.39	956.43	-0.04	-0.17
30-May	956.51	956.46	0.05	0.21
1-Jun	956.46	956.39	0.07	0.29
2-Jun	956.39	956.31	0.08	0.33
	Std. Dev. Weight Loss Last Five Days	0.06	Avg. Permeation Last Five Days	0.24

Attachment 2 Continued

	Label	Tare Weight (grams)	Fuel Density (grams/gal)	
	Tank T13S	275.51	2828	
Date	Initial Weight	Finial Weight	Weight Loss	Permeation (grams/gal/day)
22-May	973.66	973.25	0.41	1.66
23-May	973.25	972.95	0.30	1.22
24-May	972.95	972.52	0.43	1.74
25-May	972.52	972.08	0.44	1.79
26-May	972.08	971.61	0.47	1.91
27-May	971.61	971.06	0.55	2.23
28-May	971.06	970.67	0.39	1.59
30-May	970.46	969.93	0.53	2.16
1-Jun	969.93	969.45	0.48	1.95
2-Jun	969.45	968.95	0.50	2.04
	Std. Dev. Weight Loss Last Five Days	0.06	Avg. Permeation Last Five Days	1.99

	Label	Tare Weight (grams)	Fuel Density (grams/gal)	
	Tank T6-2	1725.10	2791	
Date	Initial Weight	Finial Weight	Weight Loss	Permeation (grams/gal/day)
23-May	12719.2	12715.5	3.7	0.94
24-May	12715.5	12712.2	3.3	0.84
25-May	12712.2	12709.4	2.8	0.71
26-May	12709.4	12705.3	4.1	1.04
27-May	12705.3	12702.3	3.0	0.76
28-May	12702.3	12698.8	3.5	0.89
30-May	12696.3	12692.6	3.7	0.94
1-Jun	12692.6	12689.1	3.5	0.89
2-Jun	12689.1	12685.6	3.5	0.89
	Std. Dev. Weight Loss Last Five Days	0.26	Avg. Permeation Last Five Days	0.88

Attachment 2 Continued

	Label	Tare Weight (grams)	Fuel Density (grams/gal)	
	Tank T19-2	513.50	2791	
Date	Initial Weight	Finial Weight	Weight Loss	Permeation (grams/gal/day)
23-May	2211.91	2210.38	1.53	2.51
24-May	2210.38	2208.98	1.40	2.30
25-May	2208.98	2207.55	1.43	2.35
26-May	2207.55	2206.02	1.53	2.52
27-May	2206.02	2204.53	1.49	2.46
28-May	2204.53	2203.10	1.43	2.36
30-May	2202.00	2200.43	1.57	2.60
1-Jun	2200.43	2198.96	1.47	2.43
2-Jun	2198.96	2197.55	1.41	2.33
	Std. Dev. Weight Loss Last Five Days	0.06	Avg. Permeation Last Five Days	2.44

	Label	Tare Weight (grams)	Fuel Density (grams/gal)	
	Tank T20FE	429.34	2828	
Date	Initial Weight	Finial Weight	Weight Loss	Permeation (grams/gal/day)
22-May	1264.22	1264.04	0.18	0.61
23-May	1264.04	1263.90	0.14	0.47
24-May	1263.90	1263.76	0.14	0.47
25-May	1263.76	1263.62	0.14	0.47
26-May	1263.62	1263.43	0.19	0.64
27-May	1263.43	1263.27	0.16	0.54
28-May	1263.27	1263.13	0.14	0.47
30-May	1262.98	1262.80	0.18	0.61
1-Jun	1262.80	1262.63	0.17	0.58
2-Jun	1262.63	1262.45	0.18	0.61
	Std. Dev. Weight Loss Last Five Days	0.02	Avg. Permeation Last Five Days	0.56

Attachment 2 Continued

	Label	Tare Weight (grams)	Fuel Density (grams/gal)	
	Tank T20-2	444.46	2791	
Date	Initial Weight	Finial Weight	Weight Loss	Permeation (grams/gal/day)
23-May	1263.59	1262.50	1.09	3.71
24-May	1262.50	1261.49	1.01	3.45
25-May	1261.49	1260.49	1.00	3.42
26-May	1260.49	1259.39	1.10	3.76
27-May	1259.39	1258.33	1.06	3.63
28-May	1258.33	1257.32	1.01	3.46
30-May	1256.56	1255.43	1.13	3.88
1-Jun	1255.43	1254.41	1.02	3.51
2-Jun	1254.41	1253.41	1.00	3.45
	Std. Dev. Weight Loss Last Five Days	0.05	Avg. Permeation Last Five Days	3.59

	Label	Tare Weight (grams)	Fuel Density (grams/gal)	
	Tank T23E	425.71	2828	
Date	Initial Weight	Finial Weight	Weight Loss	Permeation (grams/gal/day)
22-May	1337.91	1336.70	1.21	3.75
23-May	1336.70	1335.59	1.11	3.45
24-May	1335.59	1334.43	1.16	3.61
25-May	1334.43	1333.31	1.12	3.49
26-May	1333.31	1332.12	1.19	3.71
27-May	1332.12	1330.90	1.22	3.81
28-May	1330.90	1329.81	1.09	3.41
30-May	1328.89	1327.66	1.23	3.85
1-Jun	1327.66	1326.45	1.21	3.79
2-Jun	1326.45	1325.27	1.18	3.70
	Std. Dev. Weight Loss Last Five Days	0.06	Avg. Permeation Last Five Days	3.71

Attachment 2 Continued

	Label	Tare Weight (grams)	Fuel Density (grams/gal)	
	Tank T29-2	279.94	2791	
Date	Initial Weight	Finial Weight	Weight Loss	Permeation (grams/gal/day)
23-May	1076.22	1075.48	0.74	2.59
24-May	1075.48	1074.79	0.69	2.42
25-May	1074.79	1074.10	0.69	2.42
26-May	1074.10	1073.35	0.75	2.64
27-May	1073.35	1072.62	0.73	2.57
28-May	1072.62	1071.94	0.68	2.39
30-May	1071.37	1070.61	0.76	2.68
1-Jun	1070.61	1069.90	0.71	2.51
2-Jun	1069.90	1069.21	0.69	2.44
	Std. Dev. Weight Loss Last Five Days	0.03	Avg. Permeation Last Five Days	2.52

	Label	Tare Weight (grams)	Fuel Density (grams/gal)	
	Tank T30-2	281.51	2791	
Date	Initial Weight	Finial Weight	Weight Loss	Permeation (grams/gal/day)
23-May	1031.24	1030.55	0.69	2.57
24-May	1030.55	1029.92	0.63	2.35
25-May	1029.92	1029.23	0.69	2.57
26-May	1029.23	1028.52	0.71	2.65
27-May	1028.52	1027.83	0.69	2.58
28-May	1027.83	1027.17	0.66	2.47
30-May	1026.65	1025.92	0.73	2.73
1-Jun	1025.92	1025.26	0.66	2.47
2-Jun	1025.26	1024.61	0.65	2.44
	Std. Dev. Weight Loss Last Five Days	0.03	Avg. Permeation Last Five Days	2.54

Attachment 2 Continued

	Label	Tare Weight (grams)	Fuel Density (grams/gal)	
	Tank T42FE	420.53	2828	
Date	Initial Weight	Finial Weight	Weight Loss	Permeation (grams/gal/day)
22-May	1270.78	1270.60	0.18	0.60
23-May	1270.60	1270.26	0.34	1.13
24-May	1270.26	1270.14	0.12	0.40
25-May	1270.14	1270.01	0.13	0.43
26-May	1270.01	1269.86	0.15	0.50
27-May	1269.86	1269.70	0.16	0.53
28-May	1269.70	1269.61	0.09	0.30
30-May	1269.52	1269.31	0.21	0.70
1-Jun	1269.31	1269.14	0.17	0.57
2-Jun	1269.14	1269.01	0.13	0.43
	Std. Dev. Weight Loss Last Five Days	0.04	Avg. Permeation Last Five Days	0.51

	Label	Tare Weight (grams)	Fuel Density (grams/gal)	
	Tank T42-2	436.35	2791	
Date	Initial Weight	Finial Weight	Weight Loss	Permeation (grams/gal/day)
23-May	1274.30	1272.91	1.39	4.63
24-May	1272.91	1271.68	1.23	4.10
25-May	1271.68	1270.37	1.31	4.38
26-May	1270.37	1269.02	1.35	4.52
27-May	1269.02	1267.74	1.28	4.29
28-May	1267.74	1266.45	1.29	4.33
30-May	1265.45	1264.06	1.39	4.68
1-Jun	1264.06	1262.76	1.30	4.38
2-Jun	1262.76	1261.48	1.28	4.32
	Std. Dev. Weight Loss Last Five Days	0.05	Avg. Permeation Last Five Days	4.40

Attachment 2 Continued

	Label	Tare Weight (grams)	Fuel Density (grams/gal)	
	Tank T43FE	396.34	2828	
Date	Initial Weight	Finial Weight	Weight Loss	Permeation (grams/gal/day)
22-May				
22-May	1510.56	1510.09	0.47	1.19
23-May	1510.09	1509.62	0.47	1.19
24-May	1509.62	1509.19	0.43	1.09
25-May	1509.19	1508.76	0.43	1.09
26-May	1508.76	1508.27	0.49	1.25
27-May	1508.27	1507.82	0.45	1.14
28-May	1507.82	1507.42	0.40	1.02
31-May	1507.04	1506.56	0.48	1.22
1-Jun	1506.56	1506.10	0.46	1.17
2-Jun	1506.10	1505.66	0.44	1.12
	Std. Dev. Weight Loss Last Five Days	0.03	Avg. Permeation Last Five Days	1.14

	Label	Tare Weight (grams)	Fuel Density (grams/gal)	
	Tank T43-2	436.23	2791	
Date	Initial Weight	Finial Weight	Weight Loss	Permeation (grams/gal/day)
23-May	1575.87	1574.88	0.99	2.42
24-May	1574.88	1573.99	0.89	2.18
25-May	1573.99	1573.05	0.94	2.31
26-May	1573.05	1572.07	0.98	2.41
27-May	1572.07	1571.13	0.94	2.31
28-May	1571.13	1570.19	0.94	2.31
31-May	1569.45	1568.43	1.02	2.51
1-Jun	1568.43	1567.51	0.92	2.27
2-Jun	1567.51	1566.62	0.89	2.20
	Std. Dev. Weight Loss Last Five Days	0.05	Avg. Permeation Last Five Days	2.32

Attachment 2 Continued

	Label	Tare Weight (grams)	Fuel Density (grams/gal)	
	Tank T44-2	431.27	2791	
Date	Initial Weight	Finial Weight	Weight Loss	Permeation (grams/gal/day)
23-May	1224.78	1223.71	1.07	3.76
24-May	1223.71	1222.76	0.95	3.35
25-May	1222.76	1221.77	0.99	3.49
26-May	1221.77	1220.74	1.03	3.64
27-May	1220.74	1219.72	1.02	3.61
28-May	1219.72	1218.76	0.96	3.40
30-May	1218.01	1216.90	1.11	3.94
1-Jun	1216.90	1215.89	1.01	3.59
2-Jun	1215.89	1214.92	0.97	3.45
	Std. Dev. Weight Loss Last Five Days	0.06	Avg. Permeation Last Five Days	3.60